

SOME ANALYSES OF PLEISTOCENE DEPOSITS

IN THE EDMONTON AREA

By

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TERTIARY

Saskatchewan gravels and sands

These sands and gravels are quite widespread over the province and good sections of them are exposed in the Edmonton area. They may be observed in the Saskatchewan River valley or in some of the local gravel pits. According to Rutherford (1936), "In the district immediately adjacent to Edmonton along the Saskatchewan valley to the west of the city the sands are the more prevalent material, whereas to the east of the city and in several places somewhat removed from the city gravels are more prevalent."

The Saskatchewan sands and gravels are thought to represent Tertiary deposits as they overlie bedrock and underlie glacial material.

The coarse materials of the gravels are composed of undecomposed bedrock (of local derivation) and pebbles and boulders from the Cordilleran area. These western pebbles are largely chert, quartzitic sandstones and arkosic sandstones. The beds also carry fine gold which is most abundant near the base of the gravels.

PLEISTOCENE

Grey till

This is the oldest till observed in the area and is generally

found overlying the Saskatchewan sands and gravels. This till is observed only in low places and it appears a long erosional period followed the retreat of the glacier that laid down this deposit.

This till is gray coloured, quite thin and not very stony. The pebbles average about two inches in diameter. When dry, the till has a gray-white colour, and on fresh exposure is black, tough, and of a somewhat fissile nature.

#### Lower Interglacial stage

Overlying the Gray till in some places is a sand or peat layer that separates the lower Gray till from the overlying Brown till. This is not always present and if missing makes the separation of the Gray and Brown tills quite difficult.

The sands are clear, clean, buff, yellowish to greenish black. They have a prevailingly yellowish brown to buff colour and once seen are easily recognised elsewhere. Gravels have been observed in the sand though they are not common.

Peat (Clow, 1951) and lemming teeth have been found in these beds and are further proof of an interglacial stage. The term stage is here used to indicate a time break between the Gray and Brown tills.

#### Brown till

This till overlies the Lower Interglacial beds and the Gray till and is quite thick, sections up to 33 feet having been observed. It is brown, massive, very stony, and boulders up to twenty five inches in diameter were observed. When dry it has a light brown colour and weathers into a columnar wall (Figure 2). When wet or on fresh surface the till is sticky and pliable.

Upper Interglacial stage

Beds assigned to this stage include deposits from loess-like material to gravels. There are lake silts, clays, varved clays, sands and sand and gravel pockets and stringers. These deposits lie above the Brown till and where applicable below the Silt till. Some of the sands are not covered and appear to be represented by recent sand dunes.

The sands are wind deposited, waterlain, glacio-fluvial and predominantly gray-green to light brown in colour. The silts are a buff colour showing some bedding features and appear to be both aeolian and waterlain. The lakeing material is composed of brown clays and varved clays. Locally the brown clays show salt crystals.

There appears to be a threefold division, two sands with an intervening bed of silt or lakeing material, comprising these deposits. Outcrops showed all variations ranging from no interglacial beds through to the complete sequence. In the majority of outcrops the upper sand was missing and only the two lower phases were present.

Lemming teeth were found in the sands and give weight to interpretation as an interglacial stage. Further evidence toward the possibility of an interglacial period is the persistence of a zone of rhizocconcretions found in the silt phase of these Upper Interglacial beds. These rhizocconcretions are well exposed, in the map-area, at the Acme Brick Company clay pit (Lsd.3 Sec.27 Tp.53 R.25 W4.). Rhizocconcretions are discussed in detail by Kindle (1923) and Rousseau (1934).

The term stage is applied here with the same reservations as for the Lower Interglacial beds, only in this case as a time break

between Brown till and Silt till.

#### Silt till

This till represents the latest glaciation in the map-area. The term "Silt till" is used here for the till overlying the Brown till and Upper Interglacial beds.

The Silt till is quite variable in texture with very few cobbles or pebbles present. It is generally brown to light brown in colour, soft crushly texture and can easily be mistaken for the Brown till. The lack of stones, softer texture, and siltier nature tend to aid in differentiating this Silt till from the Brown. The presence of Upper Interglacial beds is the best criterion for establishing its identity as can be seen in Figures 3 and 4, where the Silt till overlies sand and varved clays.

#### RECENT

Deposits of Recent age form the covering mantle of the area. They are represented by soils, swamp muck, peat swamps and some river gravels and sands. The soils, which are the most significant of these Recent deposits, have all formed on the young unconsolidated deposits of drift and have a profile of a few inches to about five feet.

## METHODS OF INVESTIGATION

### STRATIGRAPHIC CORRELATION

#### General statement

The deposits described in this thesis are assembled in tabular form showing specimen number, location and stratigraphic relationship of the deposit to overlying or underlying beds. They appear in Appendix "A", Tables 1 to 6 inclusive.

#### Procedure

The placing of the deposits into the proper position in the geologic column was done at the outcrop. All specimens were thus placed on the basis of their correlated position with the "Big Bend" type section.

The assignment of the Saskatchewan gravels and sands was very readily done since in almost every case bedrock was observed below these deposits. When bedrock was not seen the position of these gravels and sands under the Gray till established their stratigraphical position.

The gray till was readily assigned to its proper position on the basis of its distinguishing colour, the overlying buff coloured interglacial sands and the underlying Saskatchewan gravels and sands.

The Lower Interglacial beds were accurately placed on the basis of their position between the lower Gray till and the upper Brown till. The colour was also an aid in their identification.

The stratigraphic placement of the Brown till was more difficult. Confusion as to whether Brown till, Silt till, or both

were exposed was the major enigma in determining this till since on casual appearance the Silt till is easily mistaken for the Brown till. The harder texture, somewhat columnar habit and greater number of cobbles and pebbles of the Brown till were the chief means of separating these two tills.

The assignment of an accurate stratigraphic position to the beds of the Upper Interglacial stage was not readily executed. Sands lie on the Gray till and also under the Silt till. Interbedded between the two sands are a group of silts, clays, varved clays and loess-like material. As previously mentioned, one, any or all of this series may be missing and thus cause confusion. Above the lower sand and in the silt there is a zone of rhizonconcretions which not only aided in fixing the position of the lower sand but also established the presence of the later silts. If no underlying beds were observed then any sand in the Upper Interglacial stage group was considered to be only of Upper Interglacial stage age and stratigraphically immediately below the Silt till.

The Silt till was, in almost every case, easily assigned to its proper place. This till lies above all other deposits in the area and hence with the soil forms the surface mantle. Some difficulty was encountered when the till was observed but lacked the pebbles or cobbles. A detailed search would always reveal the presence of such pebbles or cobbles and hence establish the outcrop as being that of the Silt till. The softer texture and the lesser number of cobbles and pebbles of the Silt till were the deciding factors in establishing its presence.

## INTERPRETATION

### STRATIGRAPHIC CORRELATION

Stratigraphic correlation was found to be an effective method of identifying the deposit and delineating the areal distribution of the deposit.

#### Saskatchewan sands and gravels

These sands and gravels were traced by the author as far west as Seba Beach, but were not observed east of the eastern boundary range 22 within the map-area. The sands and gravels are not limited to the valleys but appear throughout the map-area at elevations ranging from 2000 feet to 2310 feet above sea level. However the thickest deposits were observed in the Saskatchewan River valley.

The top of these deposits was used as the lowermost boundary of the Plioistocene in the map-area. The gravels showed every indication of being river transported and the lack of Precambrian boulders, cobbles, and pebbles suggests a western source probably in the Cordilleran.

#### Gray till.

This gray till lying above the Saskatchewan gravels and sands and below the Brown till, was very readily distinguished in the map-area. Gray till was observed at such places as Tofield, Cardiff, Devon, west of the map-area at Lake Wabamun and also south at Lebuna on the Red-River. The till appears to have, at one time, covered the entire Edmonton area and it represents the first glaciation over this area. The abundance of granites, gneisses and schists from the Precambrian establishes the till as having an eastern source and undoubtedly being a phase of the Laurentide ice-sheet.

Gray till was observed in only the topographically low places. In no place was the till exceedingly thick, reaching an observed maximum of 12 feet. Erosional features are common on the till surface and it is assumed a strong period of erosion took place after the deposition of

of this Gray till. Channels and gouges were scoured out and filled by later deposits and at the west end of the Edmonton Golf and Country Club on the north bank of the river it may be seen where the finer fractions of the till have been completely eroded out leaving only the gravel. This erosional period left the Gray till scattered throughout the country in the form of isolated patches.

#### Lower Interglacial beds

These beds are present over most of the map-area and were observed at many places including Tofield, Mearns, Elk Island Park, Devon and Fort Saskatchewan. They are generally represented by a buff, light-colored, clean, bedded and cross-bedded sand. Locally the sands were dirty and had some coarser pebbly and cobble phases present and at one locality (Lsd. 14 Sec. 36 Tp. 56 R. 26 W. 4) a peat bed was observed. Peat, which represents the first stage in coal formation, is formed from the accumulation of grasses, sphagnum and other plants in moist places. This peat layer is the first recorded occurrence at this stratigraphic position in the province. The peat was dark-brown to black in color with some fibrous material and locally quite compact.

The sands, probably in part derived from Gray till erosion, which fill the old erosional pockets and gullies appear to be stream and in part deposited by wind. The peat which developed in the low areas of the region indicated a time of plant growth and a possible rise of mean temperature. These two deposits indicate a long period of erosion following the deposition of the Gray till and an interglacial period of a considerable time.

#### Brown Till

The Brown till, lying inconformable on the Lower Interglacial beds or Gray till, was present over the entire map-area. This till has considerably greater numbers of the Precambrian clastics and like the Gray till had its source on the Canadian Shield, probably

associated with the Laurentide ice movement.

This till displays a typical columnar habit and in many places the lower part of the till sheet appears to be bedded. In some of the observed sections, the middle of the till has gravel and sand stringers and in nearly all cases the upper part of the till sheet is eroded and undulatory.

The increased number of boulders, cobbles and pebbles in this till can probably be attributed to the ice passing over the old erosion plain of the Grey till where these materials would be in abundance, being left from the erosion and washing away of the finer sand phases. The thickness of this Brown till as compared to the Grey can possibly be explained by either a thicker ice advance or a shorter period of erosion. A shorter period of erosion is favoured as the Silt till above, like the Grey till below, has very few cobbles and pebbles present. This Brown till appears to be the product of a separate ice advance on the basis of the lower, separating, interglacial beds and the very distinct color difference from the Grey till. It is difficult to reconcile only one ice advance with such diverse properties in these two till sheets.

#### Upper Interglacial Beds

These beds presented many difficulties and hence a greater number of suppositions must be made. Under this heading the sands at Winterburn, Woodbend, Glory Hills, Redwater and Elk Island Park are tentatively placed and in many places these sands are now at the surface. It is assumed these upper beds are associated with a large lake in the Edmonton area and this can be noted by reference to the glacial map (in folder) accompanying this thesis.

This glacial topography map shows a large flat area in the environs of the city of Edmonton. It is suggested a large proglacial lake occupied this area as is evidenced by the large amounts of clays, varved clays and bedded silts noted in the cutbanks of the Sturgeon and Saskatchewan rivers.

The author postulates that as the glacier responsible for the deposition of the Brown till retreated eastward it halted in the moraine & remain the center of the sheet. (Cooking Lake Moraine). As the glacier halted here amounts of sand would wash down the front and out onto the proglacial area. The dammed glacial waters would soon form a large lake and the marginal sands would be shaped into dunes by the winds prevalent in front of the glacier. In the quiet deep water, the finer clays, varved clays and bedded silts would be deposited. That the lake level was fluctuating is evidenced by the tiers of rhizoncretions observed within the silts. Here plant life probably flourished and was then covered and killed by rising or falling waters of local ice advances. As the ice retreated farther eastward this dammed body of water broke through the moraine area in the vicinity of Bruderheim and flowed in back and east of the Cooking Lake Moraine, probably removing large amounts of materials. Various erosive forces would then take the old beach and dune sands and distribute them over the lake silts.

#### Silt Till

This till has almost complete coverage over the map-area. It represents the last observed glaciation and is extremely variable in composition, texture and thickness. The only place this till was not recognized or observed was in the areas marked "sand" on the glacial map and in the extreme west of the map-area on top of the Glory Hills.

The evidence supporting this third glaciation is readily observed in the various exposures throughout the area. Figures 3, 4, and 5 all

show interglacial beds or features separating the Silt till from the Brown. There was undoubtedly a period of erosion prior to the advance of this third ice sheet but it was of a shorter duration than that of the Lower Interglacial stage. The cross-bedded and bedded sands, underlying varved clays (Figure 4) and the erosional pebble lines (Figure 5) all give evidence to confirm an interglacial period. Arkosic pebbles typical of the Saskatchewan gravels were also found in this till which suggest erosion had bared these deposits. This is the only till in which such cobbles and pebbles were found.

The author is not prepared to say from which direction this ice-advance came but does recognize the presence of a third glaciation which from the uppermost glacial deposits over the Edmonton area. The shorter erosional period of the Upper Interglacial period would not permit a large accumulation of pebbles and cobbles to be weathered out on the surface of the Brown till and hence lesser amounts of this coarser material in the Silt till. The large amount of lacustrine clays and silts over which the ice advanced would account for the finer silty nature of the Silt till in the same manner in Deane (1950) accounts for the silty nature of some of the tills in the Lake Simcoe district in Ontario.

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